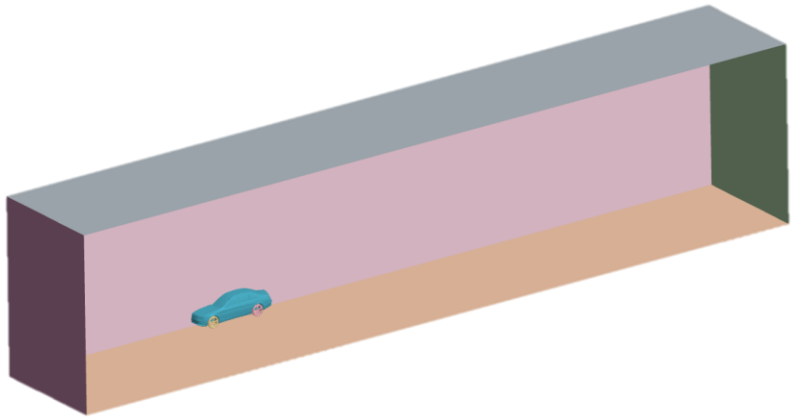
# AERODYNAMICS

## REAR VIEW CAMERA
## VS
## SIDE MIRROR

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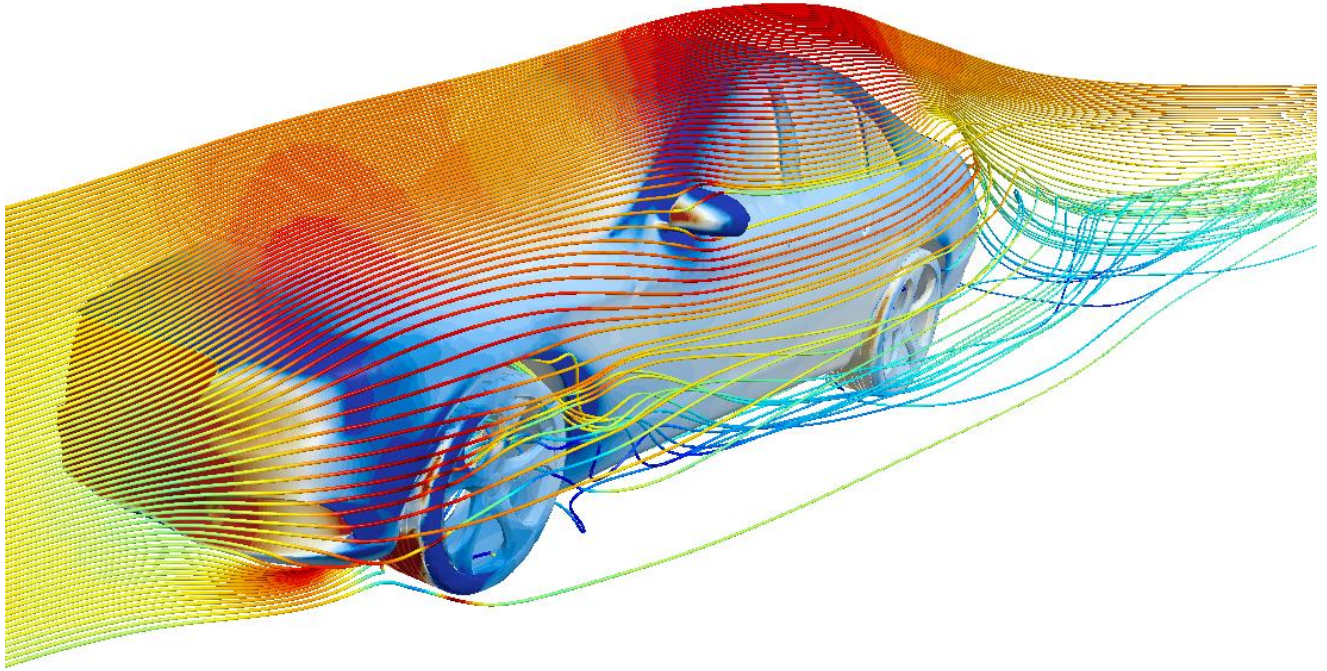
# OUTLINE

- Targets
- Problem illustration
- State of art
- Case study: CFD of Mercedes S Class 2013
- Conclusion



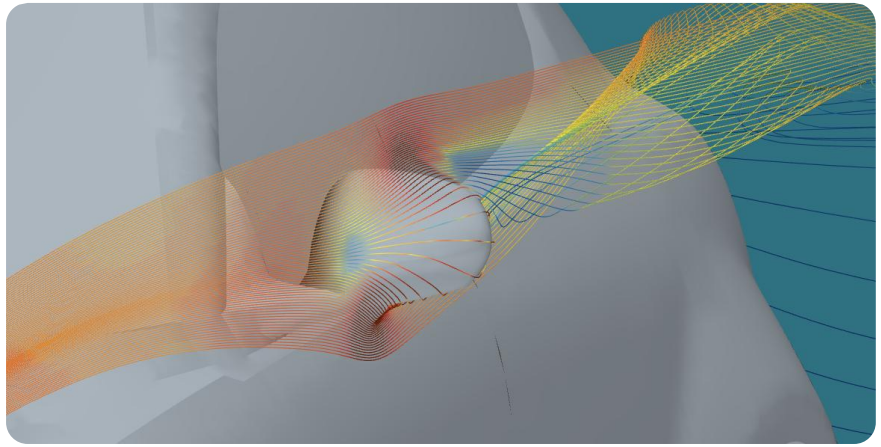
# TARGETS

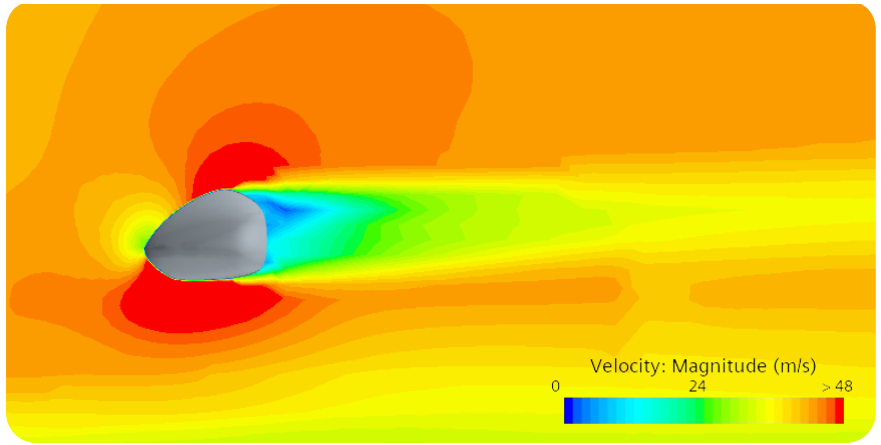
- UNDERSTAND WHAT'S ALREADY DONE IN PREVIOUS RESEARCHES.
- EVALUATION OF THE DRAG COEFFICIENT $C_d$ WITH AND WITHOUT MIRRORS IN OUR CASE STUDY.
- COMPARISON OF THE PREVIOUS RESEARCH OUTCOMES WITH THE ONES FROM OUR CASE STUDY.

# PROBLEM ILLUSTRATION

## TRADITIONAL SIDE MIRRORS

- **Drivability**: turbulences can affect vehicle stability.
- **Noise:** turbulences create noise, reducing cabin comfort at high speeds.
- **Drag**: high drag contribution decrease performance.
- **Energy efficiency:** higher emission and environmental impact due to higher fuel consumption.





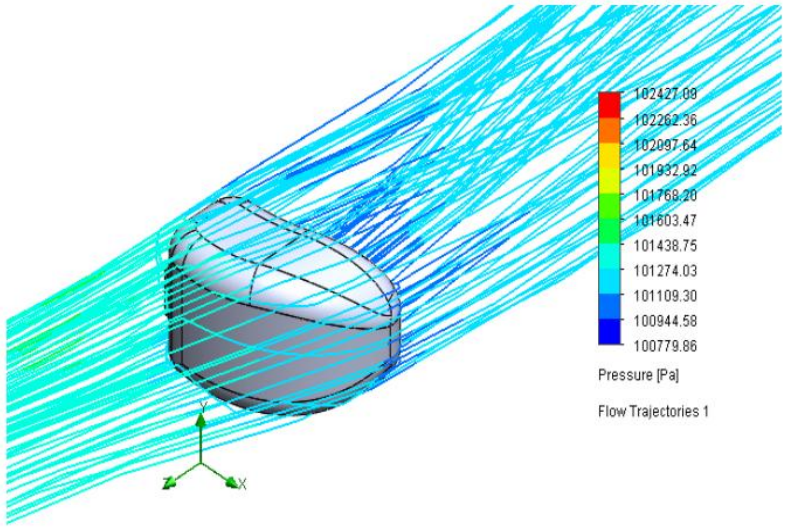
# STATE OF ART

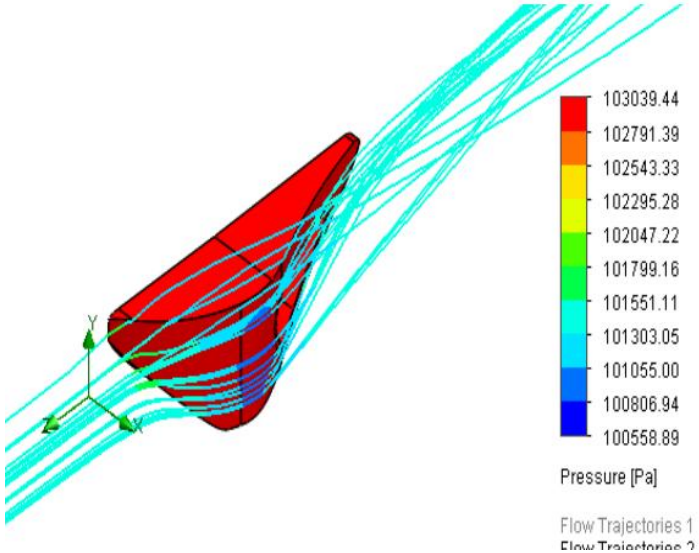
Comparison of results with and without mirror on a SUV leads to a **$\Delta C_d$ = -0.004**

| Model: | **w/ mirror** | **w/o mirror** |
|---|---|---|
| **Drag coefficient ($C_d$)** | 0.444 | 0.440 |
| **Frontal area ($m^2$)** | 2.129 | 2.081 |

*Source: Buscariolo, F.F., Rosilho, V. (2013). Comparative CFD study of outside rearview mirror removal and outside rearview cameras proposals on a current production car. SAE Technical Paper Series, 36-0298.*

# STATE OF ART




| **Traditional mirror** | | **Vortex shape camera** |
|---|---|---|
| High | Drag coefficient | Low |
| Large eddies | Flow behind the mirror | Laminar flow |
| Bad | Handling | Good |
| Standard | Visibility | Better |

*Source: Ahsan, N. Ahmad, M. Mehmood, H. Matloob, S (2021). Comparative Study and Design of outer body drag of Conventional Side-View Mirror and Vortex Side Camera using CFD.* (EJAST) European Journal of Applied Science and Technology-Novus.

# CASE STUDY

**TARGET**

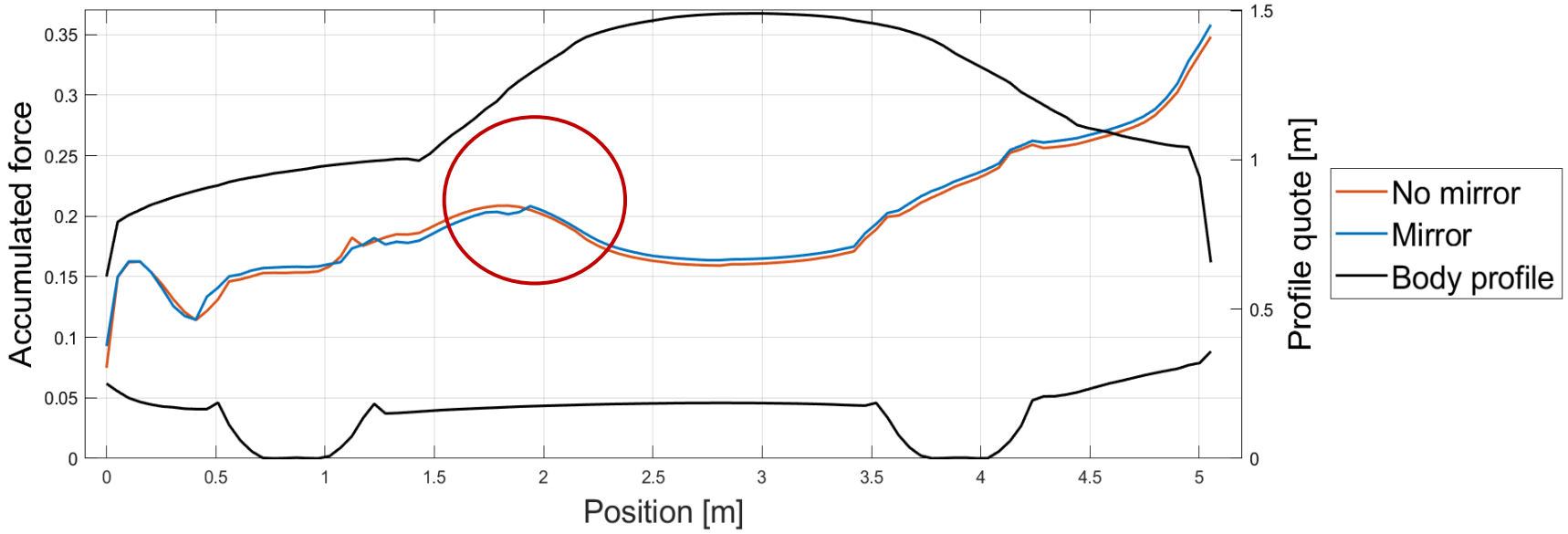
Comparison between **mirror** and **without mirror** configurations

**Negligible effect of rear-view cameras on drag coefficient** → rear-view camera can be approximated to a configuration without side mirrors

| **Vehicle** | Model | Mercedes S class 2013 |
|---|---|---|
| **Mesh** | Base size | 25 mm |
| | Type | Trimmed |
| **Test bench** | Wheel | RRS |
| | Wind speed | 38,89 m/s |
| | Turbolence model | $k-\varepsilon$ |

# CASE STUDY - RESULTS

Development of the cumulative drag coefficient on the Mercedes S Class profile

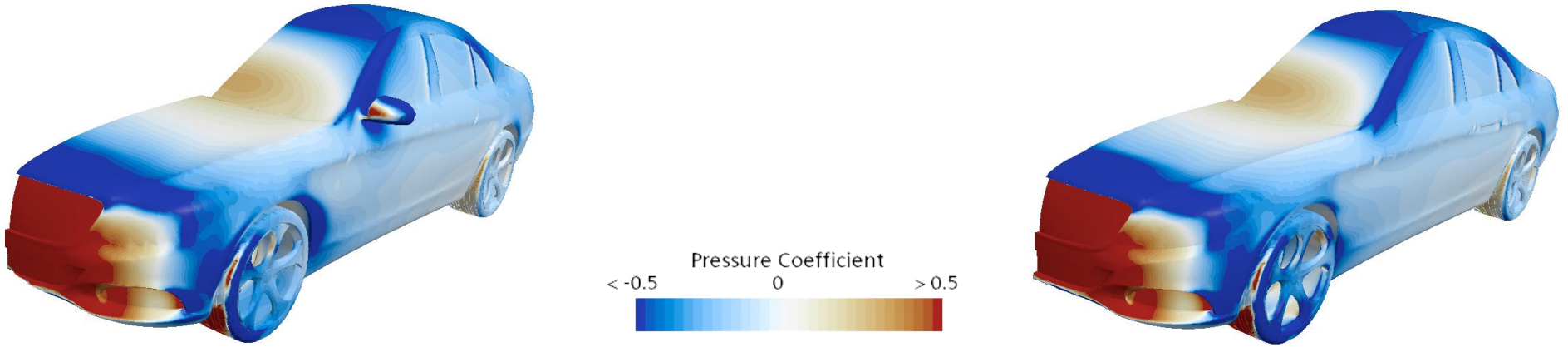



| Model: | **w/ mirror** | **w/o mirror** |
|---|---|---|
| **$C_d$** | 0.358 | 0.331 |
| **Frontal area $[m^2]$** | 1.220 | 1.193 |

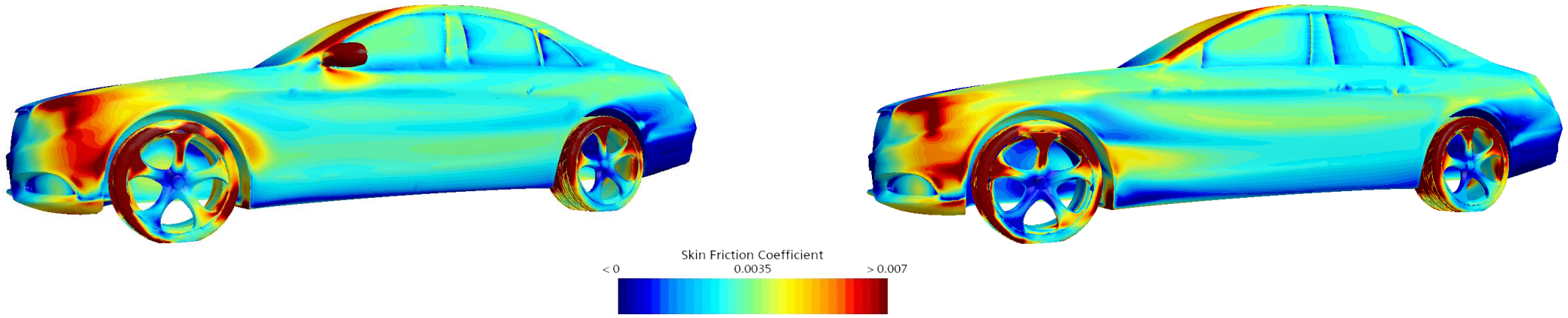
**In the mirror zone, a higher drag recovery is observed for the model without mirror.**

# CASE STUDY - RESULTS

PRESSURE COEFFICIENT

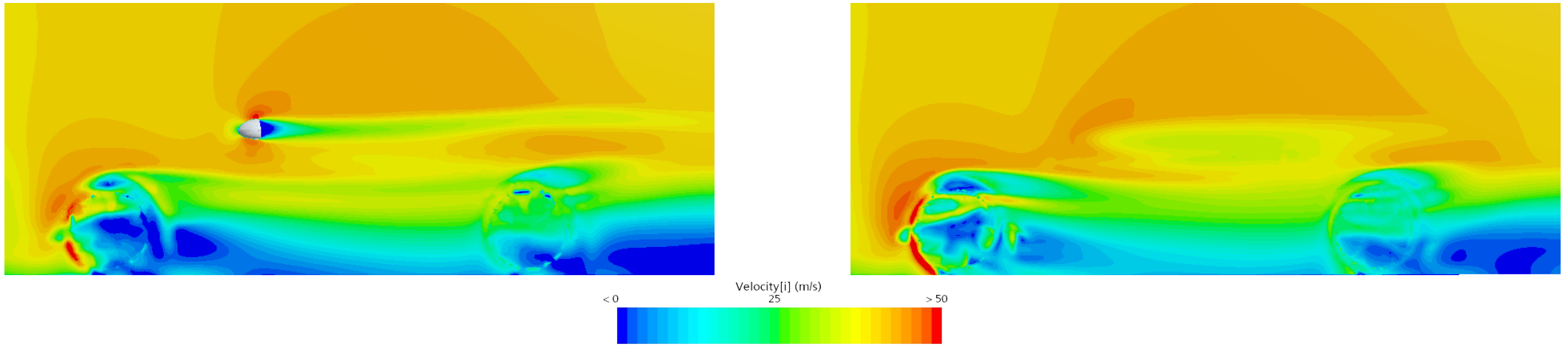



SKIN FRICTION

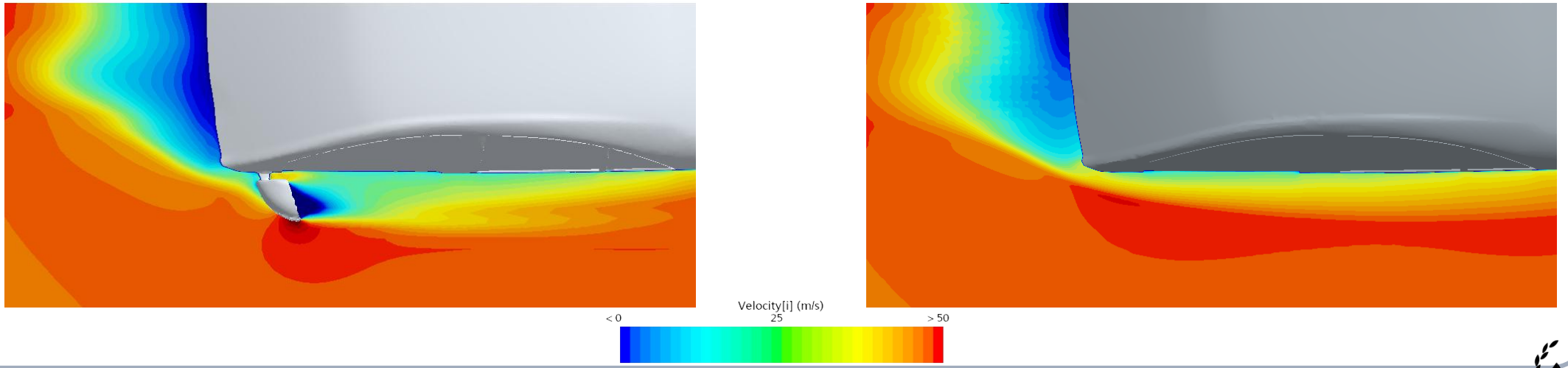


# CASE STUDY - RESULTS

VELOCITY FIELD
SIDE VIEW




VELOCITY FIELD
TOP VIEW



# CONCLUSIONS

**Drag: t**he gain in terms of drag coefficient depends on the type of the vehicle. A without-mirror configuration (and consequently a rear view camera adoption) leads to more consistent improvement of Cd on utilitary car rather than SUV.

**Rear view camera:** is easily used as aerodynamics profile, to improve Cx of the vehicle.

**Improvemets**: the result accuracy and understanding of mirror impact can be improved using a detailed vehicle model and varying wind speeds.

# THANKS FOR THE ATTENTION

## QUESTIONS?

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